

Attached are two spreadsheets providing our current cancer risk calculations associated with the HPNS RGs. The spreadsheets are not final; they are still undergoing internal review. The first spreadsheet provides risk estimates for the ingestion pathway; the second for external. The risk estimates are described as “bounding” estimates to reflect their conservative nature.

#### Risk via ingestion

The ingestion calculations (first spreadsheet) assume that the floor and lower walls of a 10' x 10' room are contaminated (32 m<sup>2</sup>). They account for decay over the 26 year exposure period and daughter concentrations where appropriate (using +D DCFPAK slope factors). To account for higher child ingestion rates we have apportioned the ingested amount over time using 95<sup>th</sup> percentile values from the EPA Exposure Factors Handbook (Table 5-33) and the BPRG calculator 16 hour/day exposure assumption. This results in ingestion of virtually all of the 32m<sup>2</sup> of contamination in the first 5 to 8 years of exposure. Even with these conservative assumptions, the ingestion risks associated with all 11 radionuclides are (individually) within the EPA risk range ( $< 1 \times 10^{-4}$ ).

The Navy's April RESRAD BUILD submittal calculates risk in a two-step conversion by applying dose conversion and slope factors to RESRAD BUILD dose estimates. The submittal assumes decay and ingrowth (RESRAD BUILD model), a larger contaminated area (43 m<sup>2</sup> v 32 m<sup>2</sup>), and that ingestion occurs at a uniform rate over the 26 year exposure period (rather than at higher rates in early years).

#### Risk via external exposure

The external calculations (second spreadsheet) use the online BPRG calculator (decay and ingrowth accounted for) with the results adjusted to reflect contamination on the floor and lower walls rather than all six interior surfaces. The adjustment factors were provided by Oak Ridge National Laboratory. We calculated risks for three different receptor locations and included the worst case (corner) in the summary tab. Other inputs are listed in the spreadsheet (e.g., concrete surfaces, 10 x 10' room). We chose to set the indoor fraction equal to one after considering the 95<sup>th</sup> percentile “time indoors” values in Table 16-1 in the Exposures Factor Handbook. (Using actual values from Table 16-1 would provide an average value slightly less than one but the difference is small.)

The Navy's April RESRAD BUILD submittal calculates risk by applying dose conversion and slope factors to RESRAD BUILD dose estimates. The submittal assumes lower values for time indoors (age-weighted value is 0.542), based on a different dataset and use of the mean rather than 95<sup>th</sup> percentile values. The calculations account for decay and ingrowth and assume the center room receptor position. The submittal also assumes contaminated floor and lower walls with a slightly larger room size (12' x 12').

#### Total risk

The first tab in the ingestion spreadsheet provides the sum of the risks for the two exposure pathways. As you'll note the total is less than  $1 \times 10^{-4}$  for all radionuclides except Cs-137, Co-60, and the two europium isotopes.

Here is a summary table:

Parent ROC	Bounding Ingestion Risk*	Bounding External Risk*	Bounding Total Risk*
<sup>241</sup> Am	5.29E-06	2.89E-07	5.6E-06
<sup>60</sup> Co	5.14E-05	2.01E-04	2.5E-04
<sup>137</sup> Cs	6.06E-05	1.37E-04	2.0E-04
<sup>152</sup> Eu	2.05E-05	2.13E-04	2.3E-04
<sup>154</sup> Eu	3.51E-05	1.71E-04	2.1E-04
<sup>3</sup> H	1.26E-07	0.00E+00	1.3E-07
<sup>239</sup> Pu	6.57E-06	4.14E-09	6.6E-06
<sup>226</sup> Ra	1.95E-05	1.17E-05	3.1E-05
<sup>90</sup> Sr	3.84E-05	2.34E-06	4.1E-05
<sup>232</sup> Th	2.28E-05	5.81E-06	2.9E-05
<sup>235</sup> U	2.08E-05	8.36E-06	2.9E-05

Two key assumptions that would need to be verified during retesting are the removable fraction (< 20%) and the extent of contamination (< 32 m2). We are still wrestling with how the latter assumption would be verified, particularly the minimum MDAs needed to verify that an area greater than 32 m2 is not contaminated and contributing significant risk.